(CVL)

CIVIL ENGINEERING

INSTRUCTIONS TO CANDIDATES

1. Candidates should write their Hall Ticket Number only in the space provided at the top left hand corner of this page and also in the space provided on the OMR Response Sheet. **BESIDES WRITING, THE CANDIDATE SHOULD ENSURE THAT THE APPROPRIATE CIRCLES PROVIDED FOR THE HALL TICKET NUMBERS ARE SHADED USING BALL POINT PEN (BLUE/BLACK) ONLY ON THE OMR RESPONSE SHEET. DO NOT WRITE HALL TICKET NUMBER ANYWHERE ELSE.**
2. Immediately on opening this Question Paper Booklet, check
   (a) Whether 200 multiple choice questions are printed (50 questions in Mathematics, 25 questions in Physics, 25 questions in Chemistry and 100 questions in Engineering)
   (b) In case of any discrepancy immediately exchange the Question Paper Booklet of same code by bringing the error to the notice of invigilator.
3. Use of Calculators, Mathematical Tables and Log books is not permitted.
4. **Candidate must ensure that he/she has received the Correct Question Booklet, corresponding to his/her branch of Engineering.**
5. **Candidate should ensure that the Booklet Code and the Booklet Serial Number, as it appears on this page is entered at the appropriate place on the OMR Response Sheet by shading the appropriate circles provided therein using Ball Point Pen (Blue/Black) only. Candidate should note that if they fail to enter the Booklet Serial Number and the Booklet Code on the OMR Response Sheet, their Answer Sheet will not be valued.**
6. **Candidate shall shade one of the circles 1, 2, 3 or 4 for corresponding question on the OMR Response Sheet using Ball Point Pen (Blue/Black) only. Candidate should note that their OMR Response Sheet will be invalidated if the circles against the question are shaded using pencil or if more than one circle is shaded against any question.**
7. One mark will be awarded for every correct answer. **There are no negative marks.**
8. The OMR Response Sheet will not be valued if the candidate :
   (a) Writes the Hall Ticket Number in any part of the OMR Response Sheet except in the space provided for the purpose.
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   (c) Adopts any other malpractice.
9. Rough work should be done only in the space provided in the Question Paper Booklet.
10. No loose sheets or papers will be allowed in the examination hall.
11. Timings of Test : **10.00 A.M. to 1.00 P.M.**
12. Candidate should ensure that he / she enters his / her name and appends signature on the Question paper booklet and also on the OMR Response Sheet in the space provided. Candidate should ensure that the invigilator puts his signature on this question paper booklet and also on the OMR Response Sheet.
13. Before leaving the examination hall candidate should **return the OMR Response Sheet** to the invigilator. Failure to return the above shall be construed as malpractice in the examination. **Question paper booklet may be retained by the candidate.**
14. This booklet contains a total of **24** pages including Cover page and the pages for Rough Work.

Set Code : M2

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Note : (1) *Answer all questions.*

(2) *Each question carries 1 mark. There are no negative marks.*

(3) *Answer to the questions must be entered only on OMR Response Sheet provided separately by completely shading with* **Ball Point Pen (Blue/Black)***, only one of the circles 1, 2, 3 or 4 provided against each question and which is most appropriate to the question.*

(4) ***The OMR Response Sheet will be invalidated if the circle is shaded using pencil or if more than one circle is shaded against each question.***

MATHEMATICS

1. If $x \neq 0$ and $\begin{vmatrix} 1 & x & 2x \\ 1 & 3x & 5x \\ 1 & 3 & 4 \end{vmatrix} = 0$, then $x =$

(1) 1 (2) -1 (3) 2 (4) -2

2. If $A = \begin{bmatrix} x & 1 \\ 1 & 0 \end{bmatrix}$ is an involutory matrix then $x =$

(1) 0 (2) 2 (3) -1 (4) 2

3. The equations $x + 2y + 3z = 1$, $2x + y + 3z = 2$, $4x + 5y + 9z = 4$ have

(1) a unique solution (2) no solution

(3) infinite number of solutions (4) two solutions

4. If A is a 2×2 matrix and $\det(2A) = k \det(A)$ then $k =$

(1) 2 (2) 4 (3) 6 (4) 8

5. If A, B are two matrices and $AB=B$, $BA=A$ then $A^2 + B^2 =$

(1) $A+B$ (2) $A-B$ (3) AB (4) 0

6. If $\frac{(x+1)^2}{x^3+x} = \frac{A}{x} + \frac{Bx+C}{x^2+1}$ then $\sin^{-1}\left(\frac{A}{C}\right) =$

(1) $\frac{\pi}{6}$ (2) $\frac{\pi}{4}$ (3) $\frac{\pi}{3}$ (4) $\frac{\pi}{2}$

7. If $\frac{x^2+5}{(x^2+2)^2} = \frac{1}{x^2+2} + \frac{K}{(x^2+2)^2}$ then $K =$

(1) 1 (2) 2 (3) 3 (4) 4

8. The value of $\cos 105^\circ =$

(1) $\frac{1-\sqrt{3}}{2\sqrt{2}}$ (2) $\frac{\sqrt{3}+1}{2\sqrt{2}}$ (3) $\frac{\sqrt{3}+1}{2}$ (4) $2+\sqrt{3}$

9. If $a\sin^2\theta + b\cos^2\theta = c$ then $\tan^2\theta =$

(1) $\frac{b-c}{a-c}$ (2) $\frac{a-c}{b-c}$ (3) $\frac{c-b}{a-c}$ (4) $\frac{a-c}{c-b}$

10. The value of $6\sin 20^\circ - 8\sin^3 20^\circ =$

(1) 2 (2) $\frac{1}{\sqrt{2}}$ (3) $\sqrt{3}$ (4) $\frac{1}{\sqrt{3}}$

11. If $\sin\theta + \operatorname{cosec}\theta = 2$ then the value of $\sin^n\theta + \operatorname{cosec}^n\theta =$

(1) 0 (2) 50 (3) 1 (4) 2

12. The sine function with period 3 is

(1) $\sin\frac{2\pi x}{3}$ (2) $\sin\frac{\pi x}{3}$ (3) $\sin 3\pi x$ (4) $\sin\frac{3\pi x}{2}$

13. The maximum value of $3\sin^2 x + 5\cos^2 x$ is

(1) 8 (2) 3 (3) 5 (4) 34

14. The smallest value of θ satisfying $\sqrt{3}(\tan\theta + \cot\theta) = 4$ is

(1) $\frac{2\pi}{3}$ (2) $\frac{\pi}{3}$ (3) $\frac{\pi}{6}$ (4) $\frac{\pi}{12}$

15. The value of $\cos\left[\sin^{-1}\left(\frac{3}{5}\right) + \sin^{-1}\left(\frac{5}{13}\right)\right] =$

(1) $\frac{33}{25}$ (2) $\frac{33}{65}$ (3) $\frac{25}{33}$ (4) $\frac{56}{65}$

16. The value of $\sin\theta + \sin(\theta + 120^\circ) - \sin(120^\circ - \theta) =$

(1) 0 (2) $\sin\theta$ (3) 1 (4) $-\sin\theta$

17. The principal solution of $3\operatorname{cosec} A = 4\sin A$ is

(1) $\frac{\pi}{4}$ (2) $\pm\frac{\pi}{3}$ (3) $\pm\frac{\pi}{6}$ (4) $\pm 2\pi$

18. The complex number z satisfying the equation $z^2 + \bar{z}^2 = 2$ forms

(1) a straight line (2) a circle (3) a parabola (4) a hyperbola

19. The value of $(1-i)^8$ is

(1) 4 (2) 8 (3) 16 (4) 256

20. The intercept on x-axis made by the circle $3x^2 + 3y^2 - 6x + 13y + 5 = 0$ is

(1) 4 (2) 3 (3) 6 (4) 2

Set Code : M2

Booklet Code : A

21. The equation of the parabola with vertex (-2, 3) and focus (1, 3) is

(1) $y^2+6y+12x-15=0$ (2) $y^2-6y-12x-15=0$

(3) $x^2-6x-12y-15=0$ (4) $y^2-6y-3x+15=0$

22. The latus rectum of the ellipse $x^2+2y^2=3$ is

(1) 2 (2) $\sqrt{3}$ (3) $2\sqrt{6}$ (4) $2\sqrt{3}$

23. The eccentricity of the hyperbola $4x^2-9y^2=2ax+b^2$ is

(1) $\frac{a}{b}$ (2) $\frac{\sqrt{b}}{a}$ (3) $\frac{\sqrt{13}}{2}$ (4) $\frac{13}{\sqrt{3}}$

24. The length of the diameter of the circle $x^2+y^2-6x-8y=0$ is

(1) 10 (2) 15 (3) 5 (4) 20

25. If the line $2y=5x+k$ touches the parabola $y^2=6x$, then $k=$

(1) $\frac{2}{3}$ (2) $\frac{4}{3}$ (3) $\frac{3}{5}$ (4) $\frac{6}{5}$

26. $\lim_{x\to 1}\frac{x^2-1}{|x-1|}=$

(1) 1 (2) -1 (3) 2 (4) -2

27. $\lim_{x\to 0}\frac{\log(x+2)}{2^x-1}=$

(1) $\log_e 4$ (2) $\log_2 e$ (3) $\log_e 2$ (4) $\log_4 e$

28. If $x=t^2, y=t^3$ then $\frac{d^2y}{dx^2}=$

(1) $\frac{3}{2}$ (2) $\frac{3t}{4}$ (3) $\frac{3}{4t}$ (4) $\frac{3}{2t}$

29. If $x^3+y^3=3axy$ then $\frac{dy}{dx}=$

(1) $\frac{x^2-ay}{ax-y^2}$ (2) $\frac{y^2+ax}{ay-x^2}$ (3) $\frac{y^2-ax}{x^2-ay}$ (4) $\frac{x^2+ay}{ax+y^2}$

30. If $y=\sin^{-1}\left(\frac{1-x^2}{1+x^2}\right)$ then $\frac{dy}{dx}=$

(1) $-\frac{2}{1+x^2}$ (2) $\frac{2}{1+x^2}$ (3) $\frac{1}{1+x^2}$ (4) $-\frac{1}{1+x^2}$

31. The slope of the normal to the curve $xy^2=4$ at (1, -2) is

(1) 2 (2) -1 (3) $-\frac{1}{2}$ (4) 1

32. The rate of change of area of a circle with respect to radius when $r = 5$cm is
(1) 2π sq.cm/sec (2) 10π sq.cm/sec
(3) 100π sq.cm/sec (4) 20π sq.cm/sec

33. The function $\frac{\log x}{x}$ attains its maximum value at $x =$
(1) 0 (2) $\sqrt{e}$ (3) e (4) $\frac{1}{e}$

34. If the increase in the side of a square is 2%, then the approximate percentage increase in the area of the square is
(1) 2 (2) 4 (3) 6 (4) 8

35. If $u = \log\left(\frac{x^2}{y}\right)$ then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} =$
(1) $2u$ (2) $3u$ (3) u (4) 1

36. $\int \text{cosec}^5\theta \cot\theta d\theta =$
(1) $\frac{\cot^2\theta}{2}$ (2) $\frac{-\text{cosec}^5\theta}{5}$ (3) $\frac{\text{cosec}^6\theta}{6}$ (4) $\frac{-\text{cosec}^6\theta}{6}$

37. $\int_2^3 \frac{dx}{x^2 - x} =$
(1) $\log\frac{2}{3}$ (2) $\log\frac{4}{3}$ (3) $\log\frac{8}{3}$ (4) $\log\frac{1}{4}$

38. The value of $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \sin|x|dx =$
(1) 0 (2) $2\sin x$ (3) 2 (4) 1

39. $\int_0^1 x\tan^{-1}x dx =$
(1) $\frac{\pi}{4} - \frac{1}{2}$ (2) $\frac{\pi}{8} - \frac{1}{2}$ (3) $\frac{\pi}{4} + \frac{1}{2}$ (4) $\frac{\pi}{8} + \frac{1}{2}$

40. $\lim_{n\to\infty} \sum_{r=0}^{n} \frac{n}{n^2 + r^2} =$
(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{3}$ (3) $\frac{\pi}{4}$ (4) $\frac{\pi}{8}$

Booklet Code : A

Set Code : M2

41. $\int_0^{\pi/4} \sec^6 x\,dx =$

(1) $\frac{8}{3}$ (2) $\frac{28}{15}$ (3) $-\frac{28}{15}$ (4) $\frac{4}{5}$

42. The area bounded by the y-axis and $x = 4 - y^2$ is ______ square units.

(1) $\frac{3}{32}$ (2) $\frac{32}{3}$ (3) $\frac{33}{2}$ (4) $\frac{9}{2}$

43. The volume of the solid generated by rotating one arch of the curve $y = \sin 3x$ about the x-axis is ----

(1) π^2 (2) $\frac{\pi^2}{2}$ (3) $\frac{\pi^2}{4}$ (4) $\frac{\pi^2}{6}$

44. The differential equations of the family of circles touching y-axis at the origin is

(1) $y^2 - x^2 - 2xyy' = 0$ (2) $(x^2 - y^2)y' - 2xy = 0$

(3) $yy' + y^2 = x^2$ (4) $2xy' - y^2 = x^2$

45. The solution of the differential equation $y\,dx - 2x\,dy = 0$ represents a family of

(1) straight lines (2) parabolas (3) circles (4) catenaries

46. If $y = x$ is a solution of $x^2y'' + xy' - y = 0$ then the second linearly independent solution of the equation is

(1) x^2 (2) $\frac{1}{x}$ (3) $\frac{1}{x^2}$ (4) x^n

47. Which of the following is an integrating factor of $\frac{dy}{dx}(x + y + 1) = 1$?

(1) e^x (2) e^y (3) e^{-x} (4) e^{-y}

48. The differential equation whose solution is $Ax^2 + By^2$, where A, B are arbitrary constants is of

(1) 1^{st} order and 1^{st} degree (2) 2^{nd} order and 1^{st} degree

(3) 2^{nd} order and 2^{nd} degree (4) 1^{st} order and 2^{nd} degree

49. The general solution of the differential equation $\frac{d^2x}{dt^2} - 4\frac{dx}{dt} + 5x = 0$ is

(1) $x = (c_1 \cos t + c_2 \sin t)e^{2t}$ (2) $t = (c_1 \cos x + c_2 \sin x)e^{2x}$

(3) $x = (c_1 \cos 2t + c_2 \sin 2t)e^{t}$ (4) $t = (c_1 \cos 2x + c_2 \sin 2x)e^{x}$

50. The particular integral of $\frac{d^2y}{dx^2} - y = \cosh x$ is

(1) $\frac{x \sinh x}{4}$ (2) $\frac{x \sinh x}{2}$ (3) $\frac{x(xe^x - e^{-x})}{4}$ (4) $\frac{x \cosh x}{4}$

PHYSICS

51. The SI unit of energy is $J = kgm^2.s^{-2}$, that of speed 'v' is $m.s^{-1}$ and of accelaration 'a' is $m.s^{-2}$. If 'm' represents the mass of the body, which of the following tells the correct answer for kinetic energy with respect to dimensional formula

(1) $K = m^2v^2$ (2) $K = ma$ (3) $K = \frac{1}{2}mv^2$ (4) $K = \frac{1}{2}m^2v^4$

52. With respect to the suitable conversion units, the values of the following blanks respectively are

$1\ kg.m^2.s^{-2}$ = _______ $g.cm^2.s^{-2}$; $3.0\ m.s^{-2}$ = _______ $km.h^{-2}$

(1) $10^7; 3.88 \times 10^4$
(2) $10^5; 3.88 \times 10^5$
(3) $10^4; 3.88 \times 10^7$
(4) $10^5; 3.88 \times 10^7$

53. The position of an object moving along x – axis is given by $x = a + bt^2$. Here $a = 8.5$ m, $b = 2.5\ ms^{-2}$. Then the average velocity between $t = 2.0$ s and $t = 4.0$ s is

(1) $150\ m.s^{-1}$ (2) $100\ m.s^{-1}$ (3) $15\ m.s^{-1}$ (4) $1.5\ m.s^{-1}$

54. If $A = 4\hat{i} + 3\hat{k} - 5\hat{j}$, $B = 2\hat{i} - 10\hat{j} - 7\hat{k}$ and $C = 5\hat{i} + 7\hat{j} - 4\hat{k}$, the value of $(A \times B) \times C$ is

(1) $7\hat{i} + 10\hat{j} + 25\hat{k}$
(2) $4\hat{i} + 11\hat{j} + 28\hat{k}$
(3) $74\hat{i} + 10\hat{j} + 28\hat{k}$
(4) $74\hat{i} + 110\hat{j} + 285\hat{k}$

55. A body moving with uniform accelaration covers a distance of 19 m in its third second and 43 m in its seventh second of its motion. The initial velocity and accelaration of the body respectively are

(1) $4\ m.s^{-1}$; $6\ m.s^{-2}$
(2) $6\ m.s^{-1}$; $4\ m.s^{-2}$
(3) $8\ m.s^{-1}$; $6\ m.s^{-2}$
(4) $4\ m.s^{-1}$; $12\ m.s^{-2}$

56. A body is at rest on the tip of a smooth inclined plane of length 15 m and angle of inclination 60° with the horizontal. Neglecting the frictional forces, the time taken for the body to reach the bottom of the inclined plane is (Assume $g = 9.8\ m.s^{-2}$)

(1) 18.8 s (2) 1.88 s (3) 0.18 s (4) 0.018 s

57. A body is projected upwards with a velocity of $14.7\ ms^{-1}$ from ground. The time taken for the body to reach the ground is (Assume $g = 9.8\ ms^{-2}$)

(1) 5 s (2) 2 s (3) 3 s (4) 4 s

58. A ball projected upwards with an initial velocity of $40\ m.s^{-1}$, reaches a maximum height of 25 m. The horizontal distance covered by the ball when it touches the ground is (Assume $g = 9.8\ m.s^{-2}$)

(1) 100m (2) 50m (3) 150.5m (4) 15.5m

59. An aeroplane is flying horizontally at an altitude of 49 m with a velocity of 200 $m.s^{-1}$. When it is just above the target a bomb is dropped. The bomb touches the ground missing the target at a horizontal distance of (Assume g = 9.8 $m.s^{-2}$)

(1) 632.4 m (2) 63.24 m (3) 6.324 m (4) 0.6324 m

60. A force of 100N is acted on a body of mass 20.0 kg placed on a rough horizontal surface. If the direction of the force is parallel to the surface and the coefficient of friction is 0.4, the accelaration produced is

(1) 10.8 ms^{-2} (2) 0.108 ms^{-2} (3) 1.08 ms^{-2} (4) 108 ms^{-2}

61. A man carries a load of 50 kg through a height of 40 m in 25s. If the power of the man is 1568W, his mass is (Assume g = 9.8 $m.s^{-2}$)

(1) 150 kg (2) 75 kg (3) 50 kg (4) 100 kg

62. A 5 kg mass is dropped from a height. The kinetic energy of the mass at the end of third second of its travel is (Assume g = 9.8 $m.s^{-2}$)

(1) 2161 J (2) 21.61 J (3) 2.161 J (4) 0.2161 J

63. Which of the following law is called the law of inertia ?

(1) Newton's second law (2) Newton's first law

(3) Newton's third law (4) Conservation law

64. The frequency of a body executing simple harmonic motion is 6 Hz. with an amplitude 0.2 m. The maximum velocity and accelaration of the body are respectively given by

(1) 7.54 ms^{-1} ; 284.2 ms^{-2} (2) 284.2 ms^{-1} ; 7.54 ms^{-2}

(3) 75.4 ms^{-1} ; 284.2 ms^{-2} (4) 7.54 ms^{-1} ; 28.42 ms^{-2}

65. A pendulum of length 80 cm has the time period of 1.8s at a place. If the period were to be 1.6s at the same place, the length of the pendulum is

(1) 63.2 m (2) 0.632 m (3) 0.0632 m (4) 6.32 m

66. If the length of a second's pendulum is halved, its period of oscillations will be

(1) 14 s (2) 0.14 s (3) 1.414 s (4) 14.14 s

67. A pipe of 30 cm long is open at both ends. The harmonic mode of the pipe that resonates a 1.1 kHz source is (Speed of sound in air is 330 ms^{-1})

(1) First Harmonic (2) Third Harmonic

(3) Second Harmonic (4) Fourth Harmonic

68. A train standing at the outer signal of a railway station blows a whistle of frequency 400 Hz in still air. The frequency of the whistle for an observer on the platform when the train approaches him at a speed of 10 ms^{-1} is

(1) 412 Hz	(2) 41.2 Hz	(3) 4.12 Hz	(4) 400 Hz

69. Two thermally insulated vessels of volumes V_1 and V_2 are joined with a valve and filled with air at temperatures T_1 and T_2 at pressures P_1 and P_2 respectively. If the valves joining the two vessels are opened, the temperature inside the vessels at equilibrium is

(1) $\frac{(P_1V_1 + P_2V_2)T_1T_2}{(P_1V_1T_2 + P_2V_2T_1)}$	(2) $\frac{P_1V_1 + P_2V_2}{(T_1T_2)(P_1V_1T_1 + P_2V_2T_2)}$

(3) $\frac{P_1V_1T_1 + P_2V_2T_2}{P_1 + P_2}$	(4) $\frac{P_1V_1}{P_2V_2}\left(\frac{T_1}{T_2}\right)$

70. The molecular kinetic energy of 1 gram of Helium at 127 °C is

(Assume Molecular weight of Helium = 4, R = 8.31 J mol^{-1} K^{-1})

(1) 130 J	(2) 1247 J	(3) 2471 J	(4) 2147 J

71. 1 gm of steam is sent into 1 gm of ice. The resultant temperature of the mixture is

(1) 270 °C	(2) 230 °C	(3) 100 °C	(4) 50 °C

72. Heat energy of 2100 J is given to a gas at a constant pressure 1.05×10^5 Pa, changing its volume to 5×10^{-3} m^3. The increase in its internal energy is

(1) 157 J	(2) 175 J	(3) 1575 J	(4) 575 J

73. The unit of water equivalent is

(1) calorie	(2) dyne	(3) gram	(4) erg

74. The potential difference that should be applied to stop the fastest photoelectrons emitted by nickel surface under the action of 20 nm uv radiations is

($h = 6.63 \times 10^{-34}$ J s., $c = 3 \times 10^8$ ms^{-1}; work function of Nickel is 5.01 eV)

(1) 5.714 eV	(2) 571.4 eV	(3) 0.5714 eV	(4) 57.14 V

75. The critical current which can flow through a long thin superconducting wire of diameter 10^{-3}m is

($H_c = 7.9 \times 10^3$ Am^{-1})

(1) 24.81 A	(2) 2.481 A	(3) 2.481 mA	(4) 24.81 mA

Set Code : M2 Booklet Code : A

CHEMISTRY

76. The maximum number of electrons which can occupy 2s orbital is
(1) 1 (2) 2 (3) 3 (4) 4

77. The electronic configuration of carbon is
(1) $1s^2 2s^2 2p^1$ (2) $1s^2 2s^2 2p^2$ (3) $1s^2 2s^2 2p^3$ (4) $1s^2 2s^2 2p^4$

78. The shape of s orbital is
(1) Dumb-bells (2) Triangle (3) Spherical (4) Double dumbbell

79. The type of Chemical bond present in Sodium chloride is
(1) Covalent bond (2) Polar Covalent bond
(3) Polar bond (4) Ionic bond

80. Which of the following compound has covalent bond ?
(1) NaCl (2) HC*l* (3) H_2O (4) H_2

81. Which solvent is also called universal solvent
(1) Ethyl acetate (2) Methanol (3) Water (4) Dichloromethane

82. One molar solution of sodium hydroxide is prepared by adding
(1) 4g/L (2) 0.4g/L (3) 0.04g/L (4) 40g/L

83. A solution is a mixture of
(1) Two solutes (2) Two solids
(3) Single Solvent (4) Solute & Solvent

84. The pH of neutral solution is
(1) 2.0 (2) 7.0 (3) 3.0 (4) 5.0

85. According to Lewis theory, acid species will
(1) Donate electrons (2) Accept electrons
(3) Accept proton (4) Donate proton

86. Which of the following is a good conductor ?
(1) De-ionized water (2) Copper
(3) Teflon (4) Bakelite

87. In galvanic cell chemical energy is converted to
(1) Electrical energy (2) Thermal energy
(3) Sound energy (4) Water

88. According to Faraday's first law, the mass of any substance deposited or liberated at electrode is directly proportional to
(1) Quantity of Electricity passed (2) Temperature of Electrode
(3) Electrode potential (4) Solution concentration

89. In a given galvanic cell the standard reduction potential of Zinc electrode is –0.76 V and that of Copper electrode is –0.40 V. The emf of the galvanic cell is
(1) 0.36V (2) 1.16V (3) –0.40V (4) –0.76V

90. Hard water contains
    (1) Small stones
    (2) Oil
    (3) Dissolved calcium & magnesium salts
    (4) Bacteria

91. The unit used to express Hardness of water is
    (1) Siemens (2) Volts (3) mg/L (4) Moles

92. Ion exchange process is done in water to remove
    (1) Solid particles (2) Colour
    (3) smell (4) Dissolved salts

93. Wet corrosion is best explained by
    (1) Bohr's theory (2) Electrochemical theory
    (3) Bronsted-Lowry theory (4) Arrhenius theory

94. By using Cathodic protection technique the corrosion of metal surface is avoided by making it work as
    (1) Salt bridge of electrochemical cell
    (2) Anode of electrochemical cell
    (3) Cathode of electrochemical cell
    (4) Insulator

95. The type of polymerization reaction while forming polyvinylchloride from vinyl chloride is
    (1) Addition polymerization (2) Condensation polymerization
    (3) Ionisation (4) Decomposition

96. Which among the below is an example of thermosetting polymer ?
    (1) Bakelite (2) Polyethelene (3) Teflon (4) polyvinyl chloride

97. The chemical used in vulcanization process to make rubber hard is
    (1) Salt (2) Chloride (3) Sulphur (4) Ethyl acetate

98. Biogas is generated when an organic compound is subjected to
    (1) Esterification (2) Aerobic decomposition
    (3) Anaerobic decomposition (4) Distillation

99. The effect of using chlorofluorocarbons on environment is
    (1) Acid rain (2) Ozone depletion
    (3) BOD (4) Sound pollution

100. Dissolved oxygen content in water is expressed in
    (1) kg (2) mg (3) ppm (4) L

Set Code : M2

Booklet Code : A

CIVIL ENGINEERING

101. The shear modulus (G), modulus of Elasticity (E) and the Poisson's ratio (μ) of a material are related as

(1) $\mu = \frac{E}{2G}(1+\mu)$ (2) $\mu = \frac{E}{2G} - 1$

(3) $E = 2G(1-\mu)$ (4) $E = G(1-2\mu)$

102. A solid metal bar of uniform diameter D and length L is hung vertically from a ceiling. If the density of the material of the bar is ρ and the modulus of elasticity is E, then the total elongation of the bar due to its own weight is

(1) $\frac{\rho E}{2L^2}$ (2) $\frac{\rho E}{2L}$ (3) $\frac{\rho L^2}{2E}$ (4) $\frac{\rho L}{2E}$

103. A bar of diameter 30 mm is subjected to a tensile load such that the measured extension on a gauge length of 200 mm is 0.09 mm and the change in diameter is 0.0045 mm. The Poisson's ratio will be

(1) $\frac{1}{3}$ (2) $\frac{1}{4}$ (3) $\frac{1}{5}$ (4) $\frac{1}{6}$

104. Hook's law is defined as

(1) Stress is proportional to strain within elastic limit.
(2) Stress is proportional to strain within proportionality limit.
(3) Stress is inversely proportional to strain within elastic limit.
(4) Stress is inversely proportional to strain within proportionality limit.

105. Elastic limit is the point

(1) up to which stress is proportional to strain
(2) at which elongation takes place without application of additional load
(3) up to which if the load is removed, original shape and volume regained
(4) at which the toughness is maximum

106. A bar of length L, uniform cross sectional area A and moment of inertia I is subjected to a pull of P. If Young's modulus of elasticity of the bar is E, the expression for strain energy stored in the bar will be

(1) $\frac{P^2L}{2AE}$ (2) $\frac{P^2L}{2EI}$ (3) $\frac{PL^2}{AE}$ (4) $\frac{P^2L}{AE}$

107. The ratio of the stress induced in a bar subjected to suddenly applied load to the stress induced by the same load applied gradually is

(1) 0.5 (2) 1.0 (3) 2.0 (4) 4.0

108. If the shear force diagram of a simply supported beam is parabolic, then the load on the beam is

(1) uniformly distributed load (2) concentrated load at mid span
(3) external moment acting at midspan (4) linearly varying distributed load

109. A simply supported beam AB of span L carries two concentrated loads W each at point $L/3$ from A and B. The shear force in the middle one third portion of the beam is

(1) $2W$ (2) W (3) $W/2$ (4) 0

110. The maximum bending moment in a simply supported beam subjected to external loading occurs
(1) always at midspan
(2) at the point of contraflexure
(3) at the point where shear force changes its sign
(4) at the point where the deflection is maximum

111. A cantilever beam AB of length L is subjected to a uniformly distributed load of w per m run for three fourth of span from the free end. The maximum bending moment at the support is
(1) $\frac{3}{8}wL^2$ (2) $\frac{3}{16}wL^2$ (3) $\frac{9}{32}wL^2$ (4) $\frac{15}{32}wL^2$

112. A simply supported beam of span 6m is subjected to a uniformly distributed load of 24 kN/m over the entire span and a concentrated load of 72 kN at a distance of 2m from the left support. The maximum reaction of support is
(1) 144 kN (2) 120 kN (3) 108 kN (4) 96 kN

113. The basic assumption of plane sections normal to neutral axis before bending remains plane and normal to the neutral axis after bending, leads to
(1) uniform strain over the beam cross section
(2) uniform stress over the beam cross section
(3) linearly varying strain over the cross section
(4) shear deformations are neglected

114. The section modulus for a solid circular cross section of radius R is
(1) $\frac{\pi R^3}{32}$ (2) $\frac{\pi R^3}{16}$ (3) $\frac{\pi R^3}{8}$ (4) $\frac{\pi R^3}{4}$

115. A symmetrical I section is subjected to a shear force F. The shear stress induced in the section is maximum at
(1) extreme fibre
(2) neutral axis
(3) the bottom of the flange in web portion
(4) the top of the flange in web portion.

116. A rectangular beam of width 200 mm and depth 300 mm is subjected to a shear force of 200 kN. The maximum shear stress produced in the beam is
(1) 3.33 N/mm^2 (2) 5.0 N/mm^2 (3) 7.5 N/mm^2 (4) 10.0 N/mm^2

117. The ratio of maximum shear stress to average shear stress in a beam with circular cross section is
(1) $\frac{2}{3}$ (2) $\frac{3}{2}$ (3) $\frac{3}{4}$ (4) $\frac{4}{3}$

118. The shape of the shearing stress distribution across a circular cross section subjected to transverse loading is
(1) triangle
(2) parabolic only
(3) rectangular only
(4) a combination of rectangular and parabolic shape

119. A shaft transmits 1000 kW of power at 100 rad/sec, then the torque transmitted is

(1) 100 kNm (2) 10 kNm (3) 1 kNm (4) 0.1 kNm

120. The polar modulus of a circular shaft of diameter D is

(1) $\frac{\pi D^3}{16}$ (2) $\frac{\pi D^3}{32}$ (3) $\frac{\pi D^3}{64}$ (4) $\frac{\pi D^2}{32}$

121. A cantilever beam of span $2L$ is subjected to a uniformly distributed load of w per m run throughout. The deflection at free end is

(1) $\frac{wL^4}{8EI}$ (2) $\frac{wL^4}{2EI}$ (3) $\frac{wL^4}{EI}$ (4) $\frac{2wL^4}{EI}$

122. A cantilever beam of span L is subjected to a concentrated load of W at midspan. The deflection under the concentrated load is

(1) $\frac{WL^3}{24EI}$ (2) $\frac{WL^3}{8EI}$ (3) $\frac{WL^3}{3EI}$ (4) $\frac{WL^3}{2EI}$

123. The deflection at the midspan of a simply supported beam of span L is subjected to a uniformly distributed load of w per m run throughout is

(1) $\frac{5}{768}\frac{wL^4}{EI}$ (2) $\frac{7}{384}\frac{wL^4}{EI}$ (3) $\frac{5}{384}\frac{wL^4}{EI}$ (4) $\frac{1}{48}\frac{wL^4}{EI}$

124. A simply supported beam of span $2L$ is subjected to a concentrated load of W at midspan. The deflection under the concentrated load is

(1) $\frac{WL^3}{48EI}$ (2) $\frac{WL^3}{16EI}$ (3) $\frac{WL^3}{8EI}$ (4) $\frac{WL^3}{6EI}$

125. The differential equation for deflection is

(1) $EI\frac{d^2y}{dx^2} = M$ (2) $EI\frac{dy}{dx} = M$

(3) $EI\frac{d^2y}{dx^2} = F$ (4) $EI\frac{d^2y}{dx^2} + EA\frac{dy}{dx} = M$

126. A uniform beam of span L is rigidly fixed at both end supports A and B. It carries concentrated load of W at midspan. The bending moment under the load is

(1) $\frac{WL}{4}$ (2) $\frac{WL}{6}$ (3) $\frac{WL}{8}$ (4) $\frac{WL}{12}$

127. A fixed beam of span L is subjected to a uniformly distributed load of w per m run throughout. The fixed end moment induced at supports is

(1) $\frac{WL^2}{8}$ (2) $\frac{WL^2}{12}$ (3) $\frac{WL^2}{16}$ (4) $\frac{WL^2}{24}$

128. A propped cantilever AB of span L is fixed at A and propped at B. The beam carries uniformly distributed load of w per m run over the entire span. The reaction of prop is

(1) $\frac{wL}{2}$ (2) $\frac{3}{8}wL$ (3) $\frac{5}{8}wL$ (4) $\frac{8}{3}wL$

129. A fixed beam AB of span 6 m is rigidly fixed at both supports A and B. It carries concentrated load of 72 kN at a distance of 2m from support A. The fixed end moment at support A is

(1) 96 kNm (2) 64 kNm (3) 54 kNm (4) 32 kNm

130. A continuous beam ABC is hinged at A and roller supports at B and C. The span AB and BC each equal to L. It is subjected to a uniformly distributed load of w per m run throughout. The reaction of the support B is

(1) $\frac{10}{8}wL$ (2) $\frac{5}{8}wL$ (3) $\frac{3}{8}wL$ (4) $\frac{1}{2}wL$

131. The Euler's crippling load for a column of length L and flexural rigidity EI with both ends fixed is

(1) $\frac{\pi^2 EI}{4L^2}$ (2) $\frac{\pi^2 EI}{L^2}$ (3) $\frac{2\pi^2 EI}{L^2}$ (4) $\frac{4\pi^2 EI}{L^2}$

132. The effective length of a column of length L fixed against rotation and translation at one end and free at the other end is

(1) $2L$ (2) $1.414L$ (3) $0.707L$ (4) $0.5L$

133. The radius of gyration of a circular column of diameter 400 mm is

(1) 200 mm (2) 100 mm (3) 50 mm (4) 25 mm

134. If the Euler load for a steel column is 1000 kN and crushing load is 1500 kN, the Rankine load is equal to

(1) 600 kN (2) 1000 kN (3) 1500 kN (4) 2500 kN

135. A structural member subjected to an axial compressive force is called

(1) beam (2) column (3) frame (4) truss

136. If ϕ is the angle of repose of soil, the coefficient of active earth pressure is

(1) $\frac{1-\sin^2\phi}{1+\sin^2\phi}$ (2) $\frac{1+\sin^2\phi}{1-\sin^2\phi}$ (3) $\frac{1-\sin\phi}{1+\sin\phi}$ (4) $\frac{1+\sin\phi}{1-\sin\phi}$

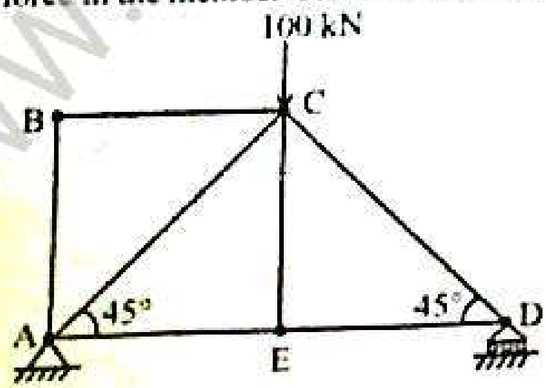
137. A retaining wall of base width b and height h is used to retain the earth at its back. For no tension to occur at the heel, the eccentricity e must be

(1) less than $b/6$ (2) greater than $b/6$
(3) less than $b/3$ (4) greater than $b/3$

138. Which of the following relation satisfies for a statically determinate truss with number of members m, number of reaction components r and number of joints j.

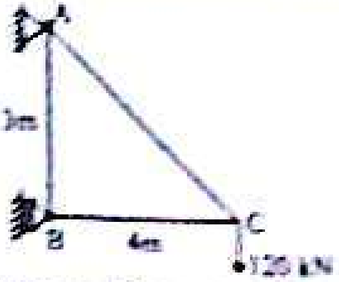
(1) $m - r = 2j$ (2) $m + r = 2j$ (3) $m + j = 2r$ (4) $r + j = 2m$

139. The force in the member CE of the truss shown in figure is



(1) 100 kN (2) 35.5 kN (3) 25 kN (4) zero

140. The force in the member AC of the truss shown in figure is



(1) 200 kN (Tension) (2) 200 kN (Compression)
(3) 150 kN (Compression) (4) 150 kN (Tension)

141. The modulus of elasticity of concrete in terms of its characteristic cube compressive strength (f_{ck}) in MPa according to IS 456-2000 is

(1) $5000 f_{ck}$ (2) $5000\sqrt{f_{ck}}$ (3) $0.7 f_{ck}$ (4) $0.7\sqrt{f_{ck}}$

142. The modular ratio for the concrete of grade M20 to be used in the analysis of RC beams using working stress method is

(1) 18.6 (2) 13.3 (3) 9.9 (4) 6.5

143. The total compressive force at the time of failure of a concrete beam section of width b considering the partial safety factor of the material is

(1) $0.8 f_{ck} b x_u$ (2) $0.66 f_{ck} b x_u$ (3) $0.54 f_{ck} b x_u$ (4) $0.36 f_{ck} b x_u$

144. A reinforced concrete T beam flange under compression having breadth of rib b_w, thickness of flange D_f and the distance between the adjacent zero moments is l_0, then the effective width of flange as per IS 456-2000 is

(1) $\frac{l_0}{3} + b_w + 6D_f$ (2) $\frac{l_0}{6} + b_w + 3D_f$

(3) $\frac{l_0}{6} + 6D_f$ (4) $\frac{l_0}{6} + b_w + 6D_f$

145. The span to depth ratio limit is specified in IS:456-2000 for the reinforced concrete beams, in order to ensure that the

(1) tensile crack width is below a limit
(2) shear failure is avoided
(3) stress in the tension reinforcement is less than the allowable value
(4) deflection of beam is below a limiting value

146. The maximum depth of neutral axis for a beam with effective depth d, in limit state method of design, for Fe 415 grade steel is

(1) 0.53 d (2) 0.50 d (3) 0.48 d (4) 0.46 d

147. Minimum tension steel reinforcement in RC beam needs to be provided to

(1) prevent sudden failure (2) arrest the crack width
(3) control excessive deflection (4) prevent surface hair cracks

148. Doubly reinforced beams are recommended when

(1) the breadth of the beam is restricted
(2) the depth of the beam is restricted
(3) both breadth and depth are restricted
(4) the shear force is high

149. If the depth of neutral axis in a beam is more than the depth of critical axis, then the beam is called as
(1) over reinforced beam (2) balanced beam
(3) under reinforced beam (4) deep beam

150. Grade of steel is designated as Fe 415, if
(1) the upper yield stress of the steel is 415 N/mm^2
(2) the ultimate stress of the steel is 415 N/mm^2
(3) the partial safety factor is 1.15
(4) the characteristic strength is 415 N/mm^2

151. The distance between the centroid of the area of tension reinforcement and the extreme compressive fibre in a reinforced concrete beam design is known as
(1) overall depth (2) effective depth
(3) lever arm (4) depth of neutral axis

152. The main reinforcement of a RC slab consists of 10 mm bars at 100 mm spacing. If it is desired to replace 10 mm bars by 12 mm bars, then the spacing of 12 mm bars should be
(1) 120 mm (2) 140 mm (3) 144 mm (4) 160 mm

153. The limits of percentage of the longitudinal reinforcement in a column is
(1) 0.15% to 2% (2) 0.8% to 5% (3) 0.8% to 6% (4) 0.8% to 8%

154. The final deflection due to all loads including the effects of temperature, creep and shrinkage and measured from as cast level of supports of floors, roofs and all other horizontal members should not exceed
(1) span/350 (2) span/300 (3) span/250 (4) span/200

155. In an RCC beam of breadth *b*, effective depth *d* and overall depth *D* exceeding 750 mm, side face reinforcement required and the allowable area of maximum tension reinforcement shall be respectively
(1) 0.2% of *bD* and 0.02 *bD* (2) 0.1% of *bd* and 0.04 *bd*
(3) 0.1% of *bD* and 0.04 *bD* (4) 0.2% of *bd* and 0.02 *bd*

156. The critical section for two-way shear of footing is at the
(1) face of the column (2) distance *d* from the column face
(3) distance *d*/2 from the column face (4) distance 2*d* from the column face

157. The minimum number of longitudinal bars provided in a reinforced concrete column of circular cross section is
(1) 4 (2) 5 (3) 6 (4) 8

158. An axially loaded column is of 300 mm × 300 mm in size and effective length of column is 3 m. The minimum eccentricity of the axial load for the column is
(1) 0 mm (2) 10 mm (3) 16 mm (4) 20 mm

159. In a RC beam, ϕ is diameter of reinforcing bar, σ_s is the stress in the bar at a section and τ_{bd} is bond stress, then the development length of reinforcing bar as per IS code in limit state design is
(1) $\frac{\phi.\sigma_s}{2\tau_{bd}}$ (2) $\frac{\phi.\sigma_s}{3\tau_{bd}}$ (3) $\frac{\phi.\sigma_s}{4\tau_{bd}}$ (4) $\frac{\phi.\sigma_s}{8\tau_{bd}}$

160. A RCC roof slab is called as a two way slab if
   (1) the slab is continuous over two opposite edges only
   (2) the slab is un-supported at one edge only
   (3) the ratio of long span to short span is > 2
   (4) the ratio of long span to short span is < 2

161. The main principle of survey is to
   (1) work from part to whole
   (2) work from whole to part
   (3) work from the centre of the area
   (4) fix positions of new locations by precise instruments

162. The distance between two points were measured with 20m chain as 500m. Afterwards it was seen that the chain was 0.08 m too long. What was the correct distance ?
   (1) 502m (2) 498m (3) 512m (4) 488m

163. The horizontal angle between the true meridian and a line is
   (1) azimuth (2) declination (3) dip (4) magnetic bearing

164. Isogonic lines pass through points of
   (1) equal dip (2) equal declination
   (3) zero dip (4) zero declination

165. If WCB of a line is 287°30', then its reduced bearing will be
   (1) N17°30'W (2) N72°30'W (3) S72°30'E (4) S17°30'W

166. If the magnetic bearing of a line is S 48°40'E and the magnetic declination at that place is 4°10' E, the true bearing of a line is
   (1) S52°50'E (2) S52°50'W (3) S44°30'E (4) S44°30'W

167. The following are the observed bearings of the lines of a traverse ABCDEA with a compass

Line	FB	BB
AB	191°45'	13°0'
BC	39°30'	222°30'
CD	22°15'	200°30'
DE	242°45'	62°45'
EA	330°15'	147°45'

   The stations free from local attraction are
   (1) C and D (2) D and E (3) E and A (4) C and A

168. The reading on the floor of a verandah of a college building is 1.815 m and staff reading when held with bottom of staff touching the ceiling over the verandah is 2.870 m. R.L of the floor is 74.500 m. Height of the ceiling above floor is
   (1) 4.270 m (2) 4.685 m (3) 3.955 m (4) 4.920 m

169. In case of leveling, back sight is
   (1) a fixed point of known elevation
   (2) the last staff reading taken before shifting the instrument
   (3) the first staff reading taken after setting the instrument
   (4) any staff reading taken on a point of unknown elevation

170. A contour may be defined as an imaginary line passing through
(1) points on the longitudinal section (2) points of equal elevation
(3) points of equal local ground slope (4) points of transverse section surveys

171. The size of the theodolite is defined according to the
(1) Length of telescope
(2) Diameter of graduated horizontal circle
(3) Height of standard
(4) Vernier plane diameter

172. The latitude and departure of a line AB are +78 m and -45.1 m respectively. The whole circle bearing of the line AB is
(1) 30^0 (2) 150^0 (3) 210^0 (4) 330^0

173. The tangential method of tacheometry is
(1) slower than stadia hair method
(2) faster than stadia hair method
(3) preferred as involves less computations to get reduced distances
(4) preferred as chances of operational errors are less compared to stadia hair method

174. Anallactic lens provided in a tacheometer is a
(1) concave lens (2) convex lens
(3) plano-convex lens (4) plane lens

175. EDM method is based on generation, propagation, reflection and subsequent reception of
(1) electrons (2) sound waves
(3) visible light waves (4) electromagnetic waves

176. A static fluid can have
(1) non-zero normal and shear stress
(2) negative normal stress and zero shear stress
(3) positive normal stress and zero shear stress
(4) zero normal stress and non-zero shear stress

177. A fluid is a said to be Newtonian when the
(1) shear stress is proportional to shear strain
(2) rate of shear stress is proportional to shear strain
(3) shear stress is proportional to rate of shear strain
(4) rate of shear stress is proportional to rate of shear strain

178. An isosceles triangular plate of base 3 m and altitude 3 m is immersed vertically in an oil of specific gravity 0.8. The base of the plate coincides with the free surface of oil. The centre of pressure from free surface will lie at a distance of
(1) 2.5 m (2) 2 m (3) 1.5 m (4) 1 m

179. The absolute pressure at a point 3 m below the clear water surface is measured as 125.5 kN/m^2. If the atmospheric pressure is taken as 101 kN/m^2, the gauge pressure in kN/m^2 at this point would be
(1) 24.4 (2) 48.8 (3) 101.0 (4) 226.5

180. Stream lines, path lines and streak lines are virtually identical for
(1) Uniform flow (2) Flow of ideal fluids
(3) Steady flow (4) Non Uniform flow

181. A streamline and an equipotential line in a flow field
(1) are parallel to each other
(2) are perpendicular to each other
(3) intersect at an acute angle
(4) are identical

182. If the error in the measurement of head in a V notch is 1%, then the error in the measurement of discharge will be
(1) 1% (2) 1.5% (3) 2% (4) 2.5%

183. The Bernoulli's equation is applicable to
(1) Both steady and unsteady flows
(2) Real fluids
(3) All fluids and flows along a stream tube
(4) Steady flow of ideal fluids along a stream tube

184. For a hydraulically efficient rectangular channel of bed width 4 m, the depth of flow is
(1) 0.5 m (2) 1 m (3) 2 m (4) 4 m

185. In long pipes, the major loss of energy is due to
(1) friction
(2) sudden contraction
(3) sudden enlargement
(4) gradual contraction or enlargement

186. The hydraulic grade line is
(1) always above the centre line of pipe
(2) always below the energy grade line
(3) always above the energy grade line
(4) always sloping downward in the direction of flow

187. Two pipes of same length with diameters d and $2d$ respectively are connected in seri
The diameter of an equivalent pipe of same length is
(1) less than d (2) between d and $1.5d$
(3) between $1.5d$ and $2d$ (4) greater than $2d$

188. For laminar flow in circular pipes, if R_e is Reynolds number then the friction facto equal to
(1) $\frac{16}{R_e}$ (2) $\frac{32}{R_e}$ (3) $\frac{64}{R_e}$ (4) $\frac{128}{R_e}$

189. The specific speed of a pump is defined as the speed of a unit such that it
(1) delivers unit discharge at unit head
(2) delivers unit discharge at unit power
(3) delivers unit power at unit head
(4) produces unit power at unit head

190. Which of the following water turbines has high specific speed ?
(1) Reaction turbine (2) Impulse turbine
(3) Pelton wheel (4) Propeller turbine

191. An isohyet is a line joining points of
   (1) equal temperature
   (2) equal humidity
   (3) equal rainfall depth
   (4) equal evaporation

192. The rainfall hyetograph shows the variation of
   (1) Cumulative depth of rainfall with time
   (2) Rainfall depth with area
   (3) Rainfall intensity with time
   (4) Rainfall intensity with Cumulative depth of rainfall

193. Dicken's formula for computing maximum flood discharge, Q, in terms of the area A and the coefficient, C_D as
   (1) $Q = C_D.A^{2/3}$ (2) $Q = C_D.A^{3/4}$ (3) $Q = C_D.A^{1/4}$ (4) $Q = C_D.A^{1/3}$

194. Given that the base period is 100 days and the duty of the canal is 1000 hectares per cumec, the depth of water will be
   (1) 0.864 cm (2) 8.64 cm (3) 86.4 cm (4) 864 cm

195. A sprinkler irrigation system is suitable when
   (1) the land gradient is steep and the soil is easily erodible.
   (2) the soil is having low permeability
   (3) the water table is low
   (4) the crops to be grown have deep roots

196. When the reservoir is full, the maximum compressive force in a gravity dam occurs
   (1) at the heel
   (2) at the toe
   (3) at the center of the base
   (4) within the middle third of the base

197. Seepage through foundation in an earthen dam is controlled by providing
   (1) chimney drain
   (2) horizontal blanket
   (3) impervious cut off
   (4) rock toe

198. For medium silt whose average grain size is 0.16 mm, Lacey's silt factor is likely to be
   (1) 0.30 (2) 0.45 (3) 0.70 (4) 1.32

199. Which of the following is a rigid dam ?
   (1) Gravity dam (2) Earth dam (3) Rockfill dam (4) coffer dam

200. The type of cross drainage work provided when the canal runs below the drain, with FSL of canal well below the bed of the drain, is
   (1) Aqueduct
   (2) Super passage
   (3) Level crossing
   (4) Siphon aqueduct